What is claimed is:

1. A method of fabricating a three-dimensional micro-optic lens on a substrate selected from a group consisting of quartz glass, silicate glass, germanium and an optically transmissive material coated with a photoresist layer, comprising:

providing a gray scale mask having a body portion and a surface layer formed thereon which is responsive to electron beam radiation to change the optical density of the surface layer;

exposing the mask to an electron beam of selected charge density over a grid of discrete locations on the mask to provide a predetermined gray scale pattern of continuously varying optical transmissivity on the mask;

exposing the photoresist layer to radiation transmitted through the mask; and

removing material from the photoresist layer and the substrate to provide a predetermined varying thickness of the substrate as determined by the gray scale patterns on the mask.

2. The method set forth in claim 1 including the step of: generating said electron beam with a current of at least about 25 nA.

3. The method set forth in claim 1 including the step of: applying an electrically conductive coating to the mask prior to exposing the mask to said electron beam and removing said coating from the mask after exposing the mask to said electron beam.

4. The method set forth in claim 1 including the step of: comparing a thickness of said photoresist layer which may be exposed to radiation with a corresponding electron beam charge density value required to darken said layer of the mask to provide a predetermined depth level in said substrate; and exposing the mask to said electron beam at a preselected charge density corresponding to the desired thickness of exposure of said photoresist layer.

5. A method for producing various depth levels in a layer of photoresist material including the steps of:

exposing a layer of photoresist material to radiation through a gray scale mask having areas of continuously varying transmissivity;

removing photoresist material from said photoresist layer to depth in said photoresist layer at a predetermined position thereon corresponding to a predetermined transmissivity of said gray scale Mask at a corresponding predetermined position on said gray scale mask; and

providing said gray scale mask as a glass article comprising a body portion and an integral ion exchanged surface layer which, upon exposure to a high energy electron beam, becomes darkened and is substantially insensitive to actinic radiation.

6. The method set forth in claim 5 including the step of: exposing said gray scale mask to selected discrete charge densities of electron beam radiation over a grid of preselected grid spacings and varying the electron beam charge density from one spacing to the next in accordance with a predetermined depth level desired to be produced in said photoresist layer.

7. The method set forth in claim 5 including the step of: comparing a thickness of said photoresist layer which may be exposed to radiation with a corresponding electron beam charge density value required to darken said gray scale mask to provide a predetermined depth level in said photoresist layer; and exposing said gray scale mask to said electron beam at a preselected charge density corresponding to the desired thickness of exposure of said photoresist layer.

8. The method set forth in claim 5 including the step of: selectively darkening a surface layer of said gray scale mask by generating an electron beam at

discrete, predetermined positions thereon and at an acceleration voltage of at least about 20 kV.

9. A method of fabricating a three-dimensional micro-element on a substrate to various depth levels comprising one of discrete depth levels and a continuous depth profile through a photoresist layer, comprising the steps of:

exposing said photoresist layer to radiation transmitted through a gray scale mask having a gray scale pattern thereon comprising image areas having a continuously varying transmissivity corresponding to a depth of material to be removed from said substrate to provide said element;

removing material from said photoresist layer and said substrate in a predetermined pattern as determined by said gray scale pattern on said mask;

providing said gray scale mask characterized as a glass article comprising a body portion and an integral radiation absorbing surface layer which is substantially insensitive to actinic radiation; and

providing said glass article with said ion exchanged surface layer having Ag+ ions therein, and/or silver halide containing and/or Ag.sub.2 O containing and/or Ag+ ion containing micro-crystals and/or micro-phases therein.

10. The method set forth in claim 9 including the step of: exposing the mask to an electron beam at a predetermined dosage corresponding to a degree of darkening of the mask required to produce a predetermined depth level in said photoresist layer.

11. The method set forth in claim 10 including the step of:
darkening the mask by generating an electron beam at an acceleration voltage in the range of 20 kV to 30 kV.

12. The method set forth in claim 10 including the step of: exposing the mask to an electron beam charge density of 0 mC/cm.sup.2 to about 400 mC/cm.sup.2.

13. The method set forth in claim 10 including the step of: generating said electron beam with a current of at least about 25 nA.

14. The method set forth in claim 10 including the step of: applying an electrically conductive coating to the mask prior to exposing the mask to said electron beam.

15. The method set forth in claim 14 including the step of: removing said coating from the mask after exposing the mask to said electron beam.

16. The method set forth in claim 10 including the step of: comparing a thickness of said photoresist layer which may be exposed to radiation with a corresponding electron beam charge density value required to darken the mask to provide a predetermined depth level in said substrate; and exposing the mask to said electron beam at a preselected charge density corresponding to the desired thickness of exposure of said photoresist layer.

17. The method set forth in claim 16 including the step of: exposing the mask to selected discrete charge densities of electron beam radiation over a grid of preselected grid spacings and varying the electron beam charge density from one spacing to the next in accordance with a predetermined depth level desired to be produced in said substrate.

18. A method of fabricating a three-dimensional diffractive optical element within photoresist which is coated on a substrate selected from a group

consisting of quartz glass, silicate glass, germanium and an optically transmissive material comprising:

providing a HEBS glass photomask blank having a body portion and a surface layer formed thereon which is responsive to electron beam radiation to change the optical density of the surface layer;

exposing the HEBS glass photomask blank to an electron beam of selected charge density over a grid of discrete locations on the photomask blank to provide a predetermined gray scale pattern of varying optical transmissivity on the photomask blank to produce a gray scale mask;

exposing the photoresist layer to radiation transmitted through the mask; and

removing material from the photoresist layer to provide a predetermined varying thickness of the photoresist layer as determined by the gray scale patterns on the gray scale mask to produce the three-dimensional diffractive optical element.